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# ISS Fluids and Combustion Facility (FCF)

## FCF Overview

**Robert Corban - NASA FCF Project Manager**

**Terence O'Malley - NASA CIR & Initial Payloads Projects Manager**

**Ronald Sicker - NASA FIR & Initial Payloads Projects Manager**

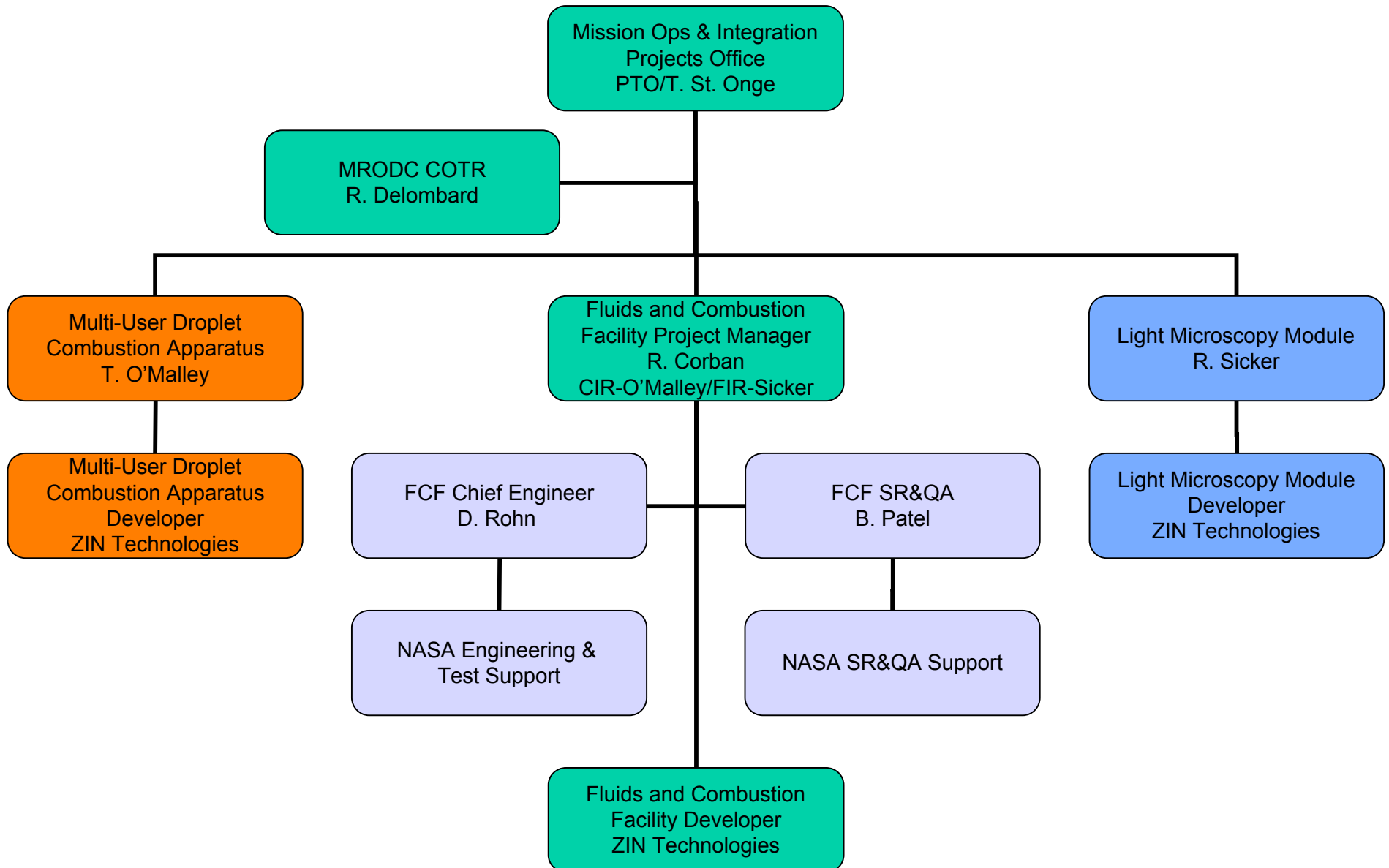




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# ISS Fluids and Combustion Facility (FCF)

## FCF Organization

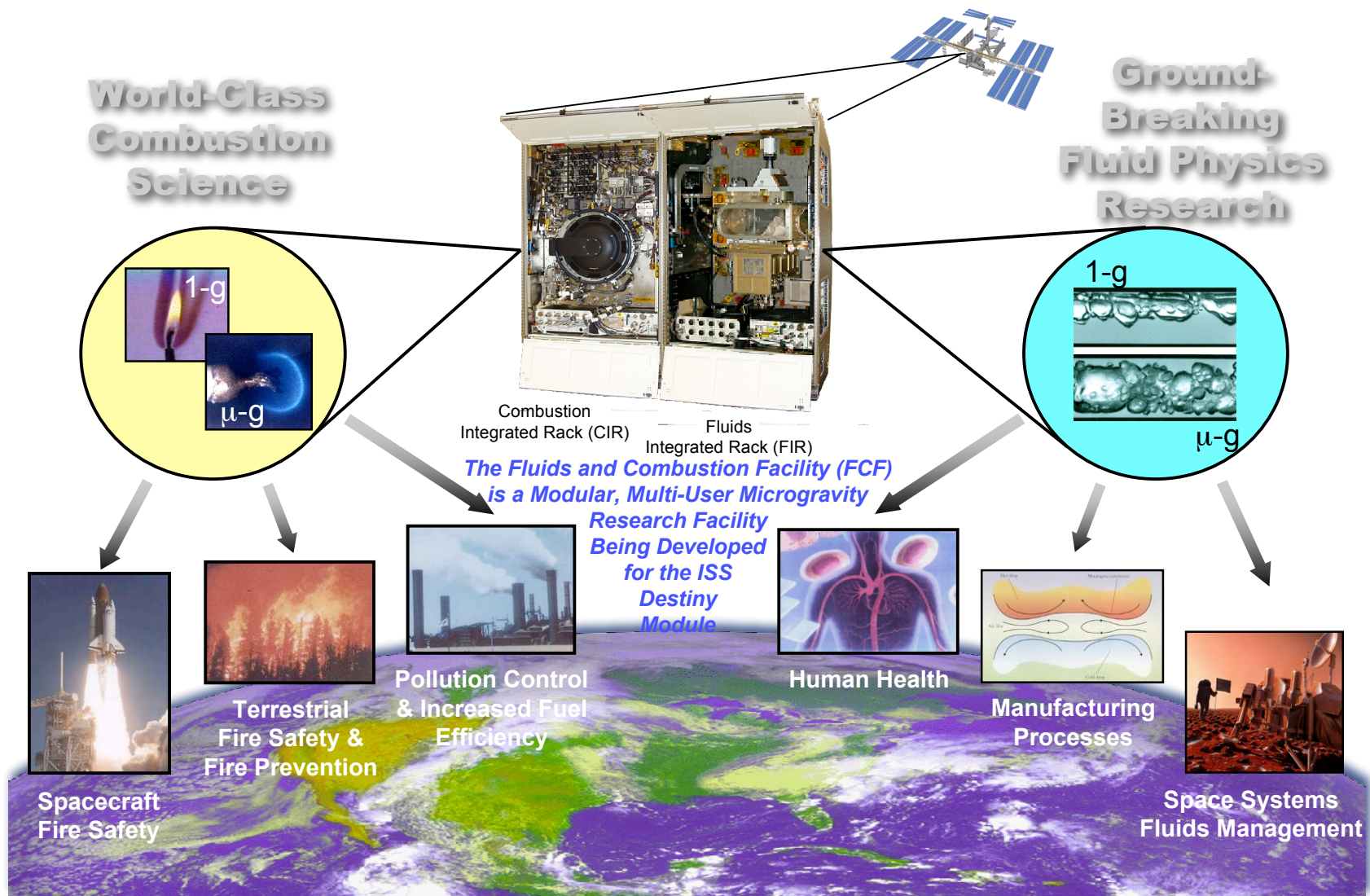




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# ISS Fluids and Combustion Facility (FCF)

## FCF Research Focus







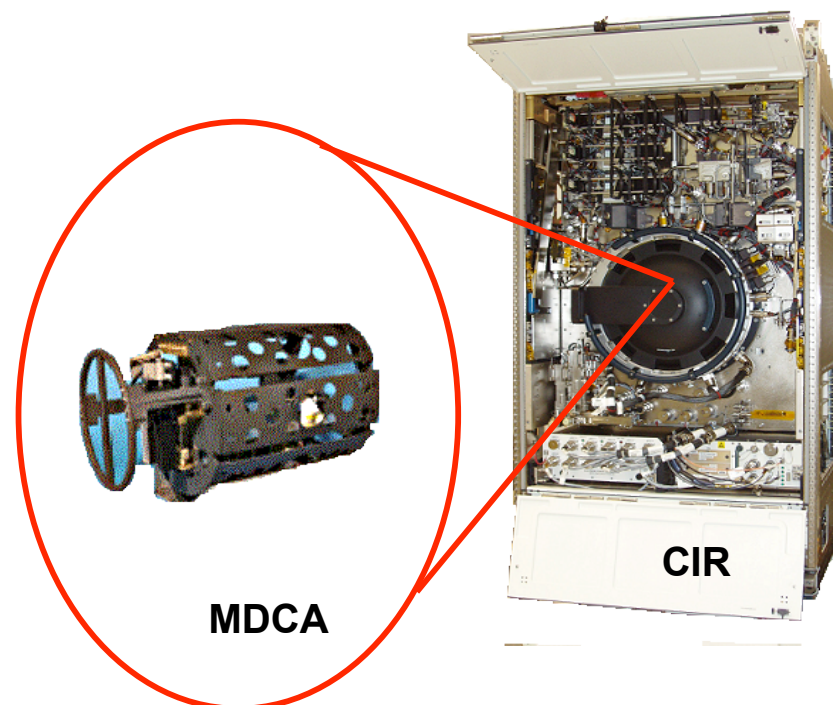
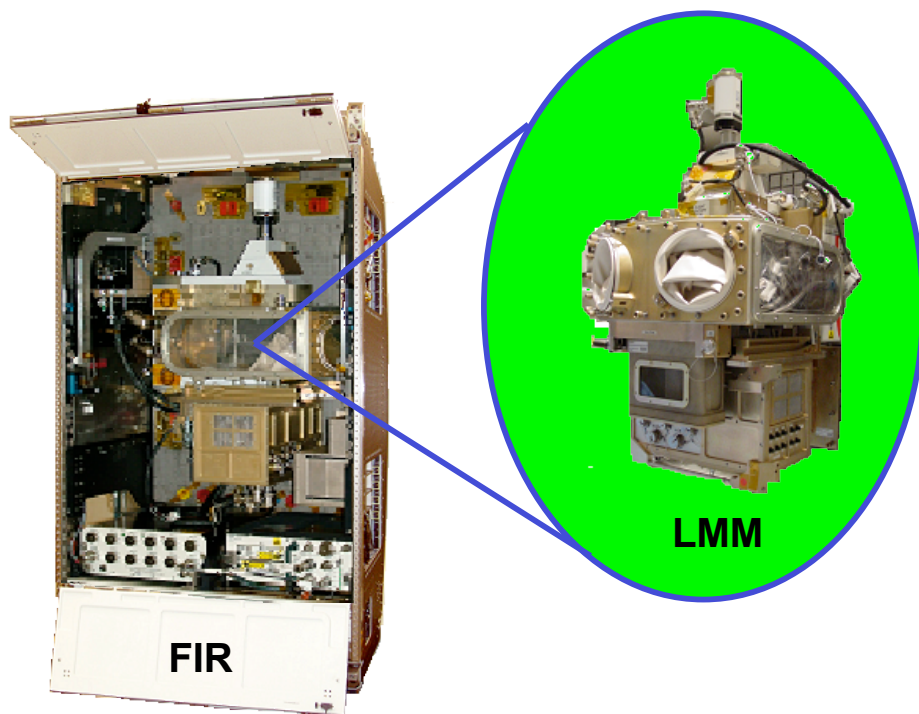
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# ISS Fluids and Combustion Facility (FCF)

## FCF Initial Payloads

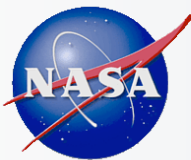
### Multi-User Droplet Combustion Apparatus (MDCA)

Initial combustion experiments performed in the FCF will be droplet combustion experiments conducted in the CIR. These experiments will study small droplets of pure alcohol and hydrocarbon fuels burning in an oxygen/inert gas atmosphere.



### Light Microscopy Module (LMM)

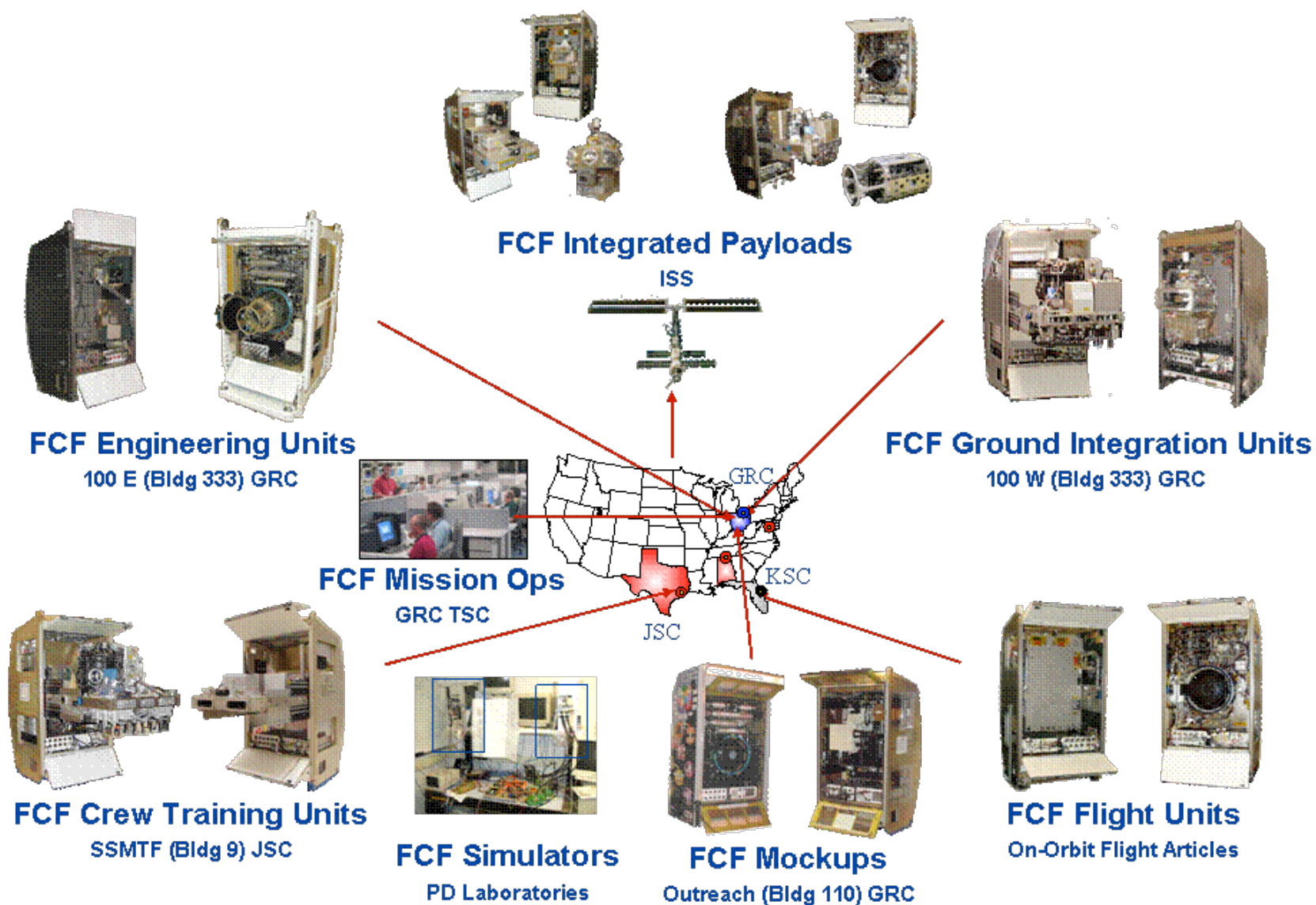
The LMM is a microscopic fluids research instrument featuring an imaging light microscope with diagnostics. Imaging techniques of high resolution video microscopy, bright field, dark field, phase contrast, differential interference contrast, fluorescence and confocal microscopy are combined in a single LMM configuration with dynamic and static light scattering techniques to allow a very broad characterization of fluids, colloids and two-phase media.

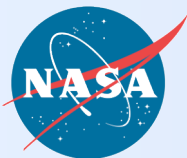


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# ISS Fluids and Combustion Facility (FCF)

## FCF Program Overview





# Combustion Integrated Rack (CIR)

WBS: 825080.04.02.20.01



**PM:** Terence O'Malley, NASA GRC  
**Engineering Team:** ZIN Technologies, Inc.

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## Objective:

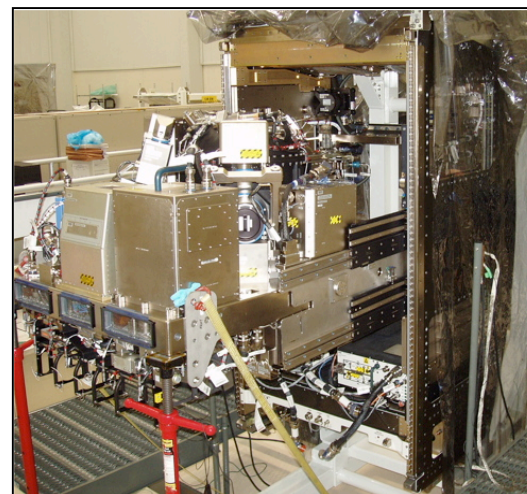
- ◆ The Combustion Integrated Rack is a facility designed to support sustained systematic combustion research and technology experiments on the International Space Station.

## Relevance/Impact:

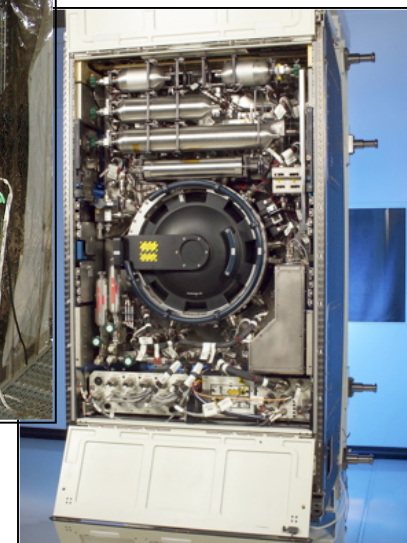
- ◆ The CIR will accommodate experiments that address critical needs in the areas of spacecraft fire safety (i.e., fire prevention, detection and suppression), incineration of solid wastes, power generation, flame spread, soot and polycyclic aromatic hydrocarbons, in-situ resource utilization, environmental monitoring and materials synthesis.

## Development Approach:

- ◆ The CIR is being developed as part of the Fluids & Combustion Facility (FCF).
- ◆ The FCF system consists of a Flight Segment and a Ground Segment.
- ◆ All avionics and diagnostics are contained in orbital replacement units with simple interfaces that allow for easy change-out/reconfiguration.
- ◆ Protoflight approach was taken for most of the hardware.
- ◆ FCF operates together with payload experiment equipment, ground-based operations facilities and the FCF ground segment.
- ◆ The CIR is designed for remote/autonomous operations.



(Above) CIR rack with bench rotated  
 (Right) CIR Flight Rack



## ISS Resource Requirements

Accommodation (carrier)	ISS US Laboratory
Upmass (kg) (w/o packing factor)	881
Volume (m <sup>3</sup> ) (w/o packing factor)	0.4 (stowed hardware)
Power (kw) (peak)	1.9 Kw
Crew Time (hrs) (initial installation & setup)	25
Launch/Increment	ULF-2/Increment 17 ⇒

## Project Life Cycle Schedule

Milestones	SCR	HCR	PDR	CDR	VRR	Safety	FHA	Launch	Ops	Return	Final Report
Actual/ Baseline	N/A	6/1998	2/2001	5/2002	2/2003	7/2005	4/2007	10/2008	Inc. 18 ⇒	TBD	TBD





# Fluids Integrated Rack (FIR)

WBS: 825080.04.02.20.01



**PM:** Ron Sicker, NASA GRC

**Engineering Team:** ZIN Technologies, Inc.

**Glenn Research Center**

## Objective:

- ◆ Develop a flexible, easily configurable, multi-use facility that provides core diagnostics and data acquisition & control capabilities that will support a broad range of research in support of Space Exploration and other endeavors.

## Relevance/Impact:

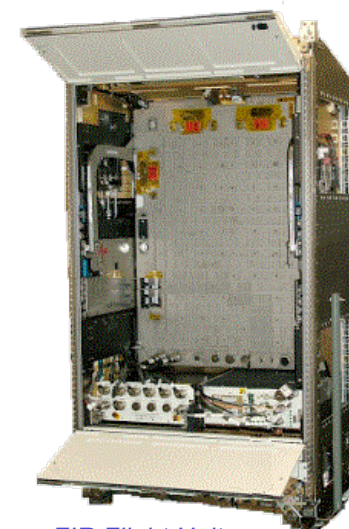
- ◆ The Fluids Integrated Rack (FIR) will support strategic research to enable storage/transfer of two-phase fluids, characterize two-phase heat transfer, support development of multi-phase environmental controls for life support systems, and support human health in physiological/medical systems research to enable long term missions to the Moon and Mars.

## Development Approach:

- ◆ The FIR is being developed as part of the Fluids & Combustion Facility (FCF).
- ◆ The FCF system consists of a Flight Segment and a Ground Segment.
- ◆ All avionics and diagnostics are contained in orbital replacement units with simple interfaces that allow for easy change-out/reconfiguration.
- ◆ Protoflight approach was taken for most of the hardware.
- ◆ FCF operates together with payload experiment equipment, ground-based operations facilities and the FCF ground segment.
- ◆ The FIR is designed for remote/autonomous operations.



*FIR with the Light Microscopy Module*



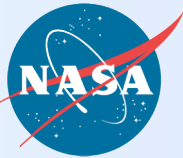
*FIR Flight Unit*

## ISS Resource Requirements

<b>Accommodation (carrier)</b>	ISS US Laboratory
<b>Upmass (kg)</b> (w/o packing factor)	745 (includes upmass for stowed ARIS hardware)
<b>Volume (m<sup>3</sup>)</b> (w/o packing factor)	0.12 (off-rack ascent volume)
<b>Power (kw)</b> (peak)	1.1
<b>Crew Time (hrs)</b> (initial installation & setup)	6
<b>Launch/Increment</b>	17A/Increment 19 ⇒

## Project Life Cycle Schedule

Milestones	SCR	HCR	PDR	CDR	VRR	Safety	FHA	Launch	Ops	Return	Final Report
Actual/ Baseline	N/A	6/1998	2/2001	12/2002	2/2003	7/2005	2/2007	4/2009	Inc. 19 ⇒	TBD	TBD



# FCF Sustaining Engineering (FCF)

WBS: 825080.04.02.20.01



**PM:** Robert Corban, NASA GRC  
**Engineering Team:** ZIN Technologies, Inc.

**Glenn Research Center**

## Objective:

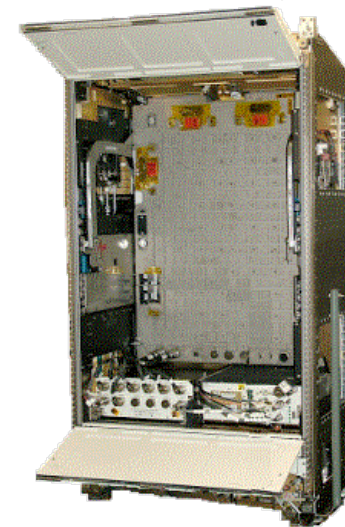
- ◆ Provide the engineering sustaining engineering support for the CIR & FIR, along with Telescience operations & FCF On-orbit operations,
- ◆ Complete all FCF products that includes any remaining GIU activities, integration and operations products, TSC readiness, and Mission Integration Planning.
- ◆ Prepare the FCF flight units for launch that includes post-storage review and flight readiness reviews.

## Relevance/Impact:

- ◆ Support strategic research on the ISS in support of the Exploration Initiative, as well as basic research.
- ◆ Provide telescience operations for the payload community in support of ISS operations.

## Development Approach:

- ◆ Maintain the Prime Contractor workforce to assure development knowledge is retained.
- ◆ Complete operational products using the existing team.
- ◆ Advocate for the FIR & CIR to be the payloads of choice for ULF-2.



*FIR Flight Unit*



*CIR Flight Unit*

## Schedule

Key Milestones/Deliverables	Date
FIR FHA	2/2007
CIR FHA	4/2007
FIR & CIR GIU Acceptance	5/2007
Spares Completed	2/2008
TSC/FCF Ops Readiness Review	3/2008
COFR	5/2008
Launch (CIR)	10/2008
MDCA On-Orbit Operations Begin	11/2008
Launch (FIR)	4/2009
LMM On-Orbit Operations Begin	5/2009